INTEGRATED CIRCUIT RECEIVER AVAILABLE FOR INFRARED OR ULTRASONIC TRANSMISSION WITH DIGITAL FILTERING

FIELD OF THE INVENTION

The present invention generally relates to an infrared or ultrasonic receiver, and more particularly, to an integrated circuit receiver available for infrared or ultrasonic transmission with digital filtering.

BACKGROUND OF THE INVENTION

Conventional infrared receiver can be typically classified into two types, one of them directly outputs the modulated or carrier signal from the infrared receiver as the output signal and thus for application it should be incorporated with an additional carrier-filtering circuitry such as an intermediate frequency (IF) filter combined with a detector to filter out the carrier component from the output signal of the infrared receiver, as shown in FIG. 1. In FIG. 1, the modulated or carrier signal from the infrared photodiode receiver front-end is amplified by an amplifier 12 and

then filtered by an IF filter 14, resulting in a larger distortion, a detector 16 and a waveform shaper 18 extract the rectangular wave and amplify it, and finally the data is outputted. The other type of infrared receiver is an infrared receiver module 20 as shown in FIG. 2, which comprises an amplifier and a carrier filter within the module 20 and is able to directly output the original or unmodulated signal.

Among the above two types of infrared receivers, the second one is more convenient for utilization since no additional carrier-filtering circuitry is necessary, however, it comes with higher cost, causing users to choose the first type and combine a carrier-filtering circuit by themselves.

On the other hand, for conventional receiver circuit available for both infrared and ultrasonic transmission, in addition to a built-in amplifier to amplify the carrier signal thereof, there is also included an analog filter to filter out the carrier component from the carrier signal, and the analog filter employed is constructed with resistors, capacitors, diodes and inductors, thereby the analog filter is not suitable for integrated circuit. However, with the advent of the technology digital filtering is developed to demodulate signals, for instance, by the Taiwan patent application no. 83213974 entitled "Improved Infrared Receiver" issued to Cheng proposed an apparatus to do signal filtering by a digital filter to avoid the

distortion and error resulted from filtering process, thereby increasing the signal reliability and accuracy.

Nevertheless, a cheap receiver available for infrared and ultrasonic transmissions with digital filtering is not disclosed. The present invention is therefore directed to an improvement of an integrated circuit infrared and ultrasonic receiver employed with digital filtering technique.

SUMMARY OF THE INVENTION

One object of the present invention is to provide an integrated circuit receiver available for infrared or ultrasonic transmission by use of digital filtering for demodulation of the carrier signal thereof, so as to reduce the cost and enhance the stabilities thereto.

According to the present invention, an integrated circuit receiver available for infrared or ultrasonic transmission comprises an infrared receiver or an ultrasonic transducer, an amplifier and a digital filter. The infrared receiver or ultrasonic transducer accepts a transmitted signal from outside of the integrated circuit receiver and outputs a modulated or carrier signal which is then amplified by the amplifier, and the amplified signal from the amplifier is transmitted to the digital filter to filter out the carrier component

thereof and so as to recover the original or unmodulated signal. The integrated circuit receiver available for infrared or ultrasonic transmission disclosed herewith is not implemented with analog filter, and it is therefore suitable to be integrated within a chip.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, reference may be had to the following description of exemplary embodiments thereof, considered in conjunction with the accompanying drawings, in which:

FIG. 1 is the circuit block diagram of a conventional infrared receiver;

FIG. 2 is the circuit schematic of a conventional infrared receiver module;

FIG. 3 is the block diagram of an embodiment according to the present invention;

FIG. 4 is a detail circuit for the implementation of the apparatus shown in FIG. 3;

FIG. 5 is a circuit block diagram of a digital filter for the apparatus shown in FIG. 3; and

FIG. 6 shows the output waveforms from each circuit block of the apparatus shown in FIG. 3.

DETAILED DESCRIPTION OF THE INVENTION

The block diagram of an embodiment according to the present invention is shown in FIG. 1, in which an infrared receiver 10 or ultrasonic transducer 22 accepts a transmitted signal from outside and outputs a modulated or carrier signal. The output from the infrared receiver 10 or ultrasonic transducer 22 is fed to an amplifier circuit 24, and the amplified signal thus produced by the amplifier circuit 24 is further fed to a digital filter 26 to filter out the carrier component thereof, and therefore the original or unmodulated signal is recovered. When no transmitted signals outside are present, the output of the amplifier circuit 24 remains at a silent voltage.

A detail circuit for implementation of the apparatus shown in FIG. 3 is further provided in FIG. 4, in which the infrared receiver 10 or ultrasonic transducer 22 accepts the transmitted signal from outside and outputs the modulated or carrier signal. The output from the infrared receiver 10 or ultrasonic transducer 22 is fed to an

amplifier 28, and the output from the amplifier 28 is inverted by an inverter 30 and then fed to the PR port 324 of a first D type flip-flop 32, which has its Q port 325 connected to the D port 342 of a second D type flip-flop 34. A sampling frequency clock is connected to the clock port CLK 323 of the first D type flip-flop 32 and through an inverter 36 to the clock port CLK 343 of the second D flip-flop 343. The unmodulated signal is outputted from the Q port 345 of the second D type flip-flop 34. Respective clear ports CL 321 and 341 of the D type flip-flops 32 and 34 are connected to a power supply Vcc, and the complementary Q ports /Q 326 and 346 are left floating. The D port 322 of the first D type flip-flop 32 is grounded, and the preset port PR 344 of the second D type flip-flop 34 is also connected to voltage Vcc.

FIG. 5 shows the block diagram of a digital filter, in which the digital filter 26 is fed with the amplified output signal that is amplified by the amplifier 28 with the output signal from the infrared receiver 10 or ultrasonic transducer 22. When the amplified output signal is inputted to the digital filter 26, the output of the fixed-interval reset circuit 38 within the digital filter 26 is set ON. The clock 44 for the fixed-interval reset 38 and a sample circuit 40 is connected to the fixed-interval reset circuit 38 and through an inverter 42 to the fixed-interval sample circuit 40. The fixed-interval reset circuit 38 resets its output to OFF every interval t. When an infrared or ultrasonic signal is detected and under the

circumstances of the reset period t of the fixed-interval reset circuit 38 is greater than the period of the carrier signal for infrared or ultrasonic transmission, the unmodulated or original signal will be fetched and outputted and the influence of the duty cycle is avoided. Finally the fixed-interval sample circuit 40 outputs the waveform, the unmodulated or original signal is recovered and demodulation is achieved.

The output waveforms from each circuit block of the above embodiment are shown in FIG. 6. The waveform in FIG. 6(a) is the amplified output signal, i.e., the modulated or carrier signal from infrared receiver 10 or ultrasonic transducer 22 after amplified by the amplifier circuit 24. The waveform in FIG. 6(b) is the clock signal, by which the fixed-interval reset circuit 38 is trigger on its rising edge and the fixed-interval sample circuit 40 is triggered on its falling edge. The waveform in FIG. 6(c) is the output of the fixed-interval reset circuit 38. The waveform in FIG. 6(d) is the output of the fixed-interval sample circuit 40.

This manner the disclosed apparatus filters out the carrier component by use of digital filtering and detects the infrared or ultrasonic carrier signal by fixed-interval sampling to achieve filtering. Furthermore, since no analog filter is needed, it is suitable to be integrated within a chip.

From the above, it should be understood that the embodiment described, in regard to the drawings, is merely exemplary and that a person skilled in the art may make variations and modifications to the shown embodiment without departing from the spirit and scope of the present invention. All variations and modifications are intended to be included within the scope of the present invention as defined in the appended claims.